16. A Multi-Objective Decision-Support System (MODSS) with Stakeholders and Experts in the Hodgson Creek Catchment

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This chapter reports the MODSS analysis conducted in the Hodgson Creek catchment on the Darling Downs. It summarises the process used to gain stakeholder and technical input into the analysis. Options and criteria developed for the Hodgson Creek analysis are also described briefly, as is the effects table. The results of the multi-criteria analysis are presented and discussed.

16.1 The Process of Developing a MODSS for Farm Forestry in Hodgson Creek

The MODSS for Farm Forestry in Hodgson's Creek was developed through an extended process including consultation with stakeholders and technical experts. Input from stakeholders was sought in a one-day workshop at Felton, in the Hodgson Creek catchment. Input from experts was sought in two one-day workshops. The MODSS development process is summarised below:

Phase 1 – Development of options, criteria, and importance orders

1. An initial MODSS workshop to identify a preliminary list of options and criteria was conducted involving only technical experts (without the assistance of spatial information). The results from the initial MODSS workshop were the starting point of the second analysis (involving both stakeholders and technical experts).
2. The first round results were presented to the stakeholder reference group, along with detailed descriptions of the options including maps of the possible spatial extent of the options.
3. Options and criteria were further discussed in the stakeholder workshop.
4. A final set of options was defined from the preferences of the stakeholder group. Options were removed or substantially changed to reflect the views of this group.
5. A similar process occurred with the criteria, which were evaluated with regards to their relevance and importance to the stakeholder group. During this process, some criteria were added, removed or modified. Three stakeholder factions were present at this meeting, and each faction produced separate importance orders. These factions were landholders, state government extension officers (from the Queensland Department of Primary Industries and the Queensland Department of Natural Resources and Mines) and local government officers (of the Pittsworth Shire Council).
6. This new set of options, criteria and importance orders formed the basis of the second round analysis.

Phase 2 – Development of effects table

1. Persons with local farm forestry knowledge were invited to form the Technical Reference Group (TRG) for the final analysis.
2. The options were scored against the criteria during two focus group sessions. The options were assessed using the considered opinions of those experts present.
3. The options were considered at two time scales, initially defined as the short term and long term. The TRG further defined these periods. Final definitions were (1) the *Transitional period*, that time during which the new forestry industry is being established in the catchment,

also defined as the *Cost period*, of the first five to 10 years, and (2) the *Steady-state period* or the *Equilibrium period*, the time when a forestry industry has been established in the catchment, at about year 30 to 40.

Phase 3 – Resolution of effects table and ranking of options

1. The effects table was analysed using the MCA tool Definite. The analyses used three rankings representing the views of the three factions. The criteria were also placed into a hierarchy and separated in economic, environmental and social criteria.
2. Two aggregation methods were used, these being:
3. the weighed summation technique, used for it's transparency and acceptability with stakeholder groups; and
4. the Electré II technique, used to highlight any poor performance in an individual criterion.
5. The results of this analysis from the perspective of the landholder faction are presented in the body of this chapter; those of the other two factions are provided in Appendices 16.3 and 16.4. Differences in the results are discussed in the Section 16.9.

16.2 The Farm Forestry Options

The forestry options considered in the Hodgson creek MODSS are as follows:

1. An approximation of current land-use

This scenario is based on assumptions about 'typical' land-uses and includes various possible and likely land-uses. This option provides a baseline against which the others are measured. For an alternative land-use to be viable it must perform better or at least as well as the current land-use.

2. High-priority salinity prevention

This option involves identifying saline and at-risk areas in the catchment, especially the discharge zones. This option involves farm forestry on the associated recharge zones, higher in the catchment.

3. Medium-priority salinity plantings

This option is the same as Option 2, but with a greater proportion of the recharge area planted.

4. Additional under-used areas

This option is the same as Options 2 and 3, but with additional areas recognized as having limited value for conventional agricultural production, being planted with trees, especially if adjacent to the priority salinity areas.

5. Commercial plantations (with corporate land ownership)

This option is based on a medium-scale corporate investment in purchase of land and establishment of forestry in the higher rainfall areas of the region.

6. Commercial plantations (with leased land)

This option is the same as Option 5, except land is leased by the corporation from landholders (potentially increasing the availability and decreasing the cost of land).

7. Private medium-sized plantations

This option is based on a medium-scale forestry planting, undertaken by landholders.

8. Agroforestry (plantations and grazing)

This option involves the establishing of wide-spaced plantations, in conjunction with improved or native pasture or even fodder crop strips in more fertile areas.

16.3 The Criteria for Evaluating the Farm Forestry Options

The performance criteria used to evaluate the forestry options considered in the Hodgson creek MODSS are listed below (and described more fully in Chapter 14).

Economic criteria

Forestry revenue – growth
Forestry revenue – royalty
Infrastructure costs (community)
Regional impact
Regional output
Profit – farm (in transitional or steady-state period)
Profit – regional (in transitional or steady-state period)
Property value
Rating treatment
Risk profile
Risk of policy change
Equity of financial returns
Cash flow – upfront costs
Cash flow – debt servicing
Critical mass
Flexibility of land-use
Liquidity of assets

Environmental criteria

Shelter effects
Soil resource quality
Carbon sequestration
Water quality
Salinity control
Biodiversity (local native)
Water quantity
Cumulative impacts
Displacement of existing native bio systems
Habitat quality
Pest habitat
Air quality (spraying of agricultural chemicals)

Social criteria

Aesthetic amenity
Change management requirements (including reskilling)
Consistency with local state fed government regulation/policy
Net employment
Maintaining services
Community capacity

Community cohesion
Community acceptance
Population turnover
Equity
Community health
Health effects on family

16.4 Importance Orders Applied to the Decision Criteria

Importance orders were elicited from three separate stakeholder groups, namely local landholders, officers from the local shire council and extension staff from state government agencies. It should be noted that the importance orders were personal preference of those questioned, and were not necessarily a reflection of the policy or practice of the agency that employed them. Table 16.1 presents the importance order defined by the local landholders. The importance orders defined by officers from the local shire council and extension staff from state government agencies can be found in Appendices 16.3 and 16.4 respectively.

Table 16.1. Relative importance of the criteria as defined by landholders

Performance criterion	Relative importance
Economic	
Forestry revenue – growth	5 (Not significant)[1]
Forestry revenue – royalty	5 (Not significant)
Infrastructure costs (community)	4
Regional impact	4
Regional output ($)	4
Profit (regional)	1
Profit (farm)	1
Property value	3
Rating treatment	4
Risk profile	2
Risk of policy change	4
Equity of financial returns	4
Cash flow – upfront costs	2
Cash flow – debt servicing	2
Critical mass	4
Flexibility of land-use	3
Liquidity of assets	3
Environmental	
Shelter effects	2
Soil resource quality	1
Carbon sequestration	4
Water quality	1
Salinity control	1
Biodiversity (local native)	2
Water quantity	2
Cumulative impacts	2
Displacement of existing native bio-systems	3
Habitat quality	3
Pest habitat	1
Air quality (spraying of agricultural chemicals)	1

[1] The landholder stakeholder group considered these criteria as insignificant to their decision-making; subsequently, these criteria were placed as the least important in the rank order, a rank of 5.

Social	
Aesthetic amenity	1
Change management requirements (including reskilling)	4
Consistency with local state federal government regulation/policy	2
Net employment	3
Maintaining services	3
Community capacity	3
Community cohesion	2
Community acceptance	2
Population turnover	2
Equity	2
Community health	2
Health effects on family	1

16.5 The Effects Tables for the Hodgson Creek Study

All the criteria were scored on scale of one to 10, 10 being the best possible score. As this was the initial iteration of the analysis, the options were all scored according to the opinions of the members of the technical reference group. To account for the long-term nature of farm forestry investment and the time preferences of stakeholders, options were scored for two time periods, namely the 'transitional period' (5 to 10 years) during which the farm forestry option under consideration is becoming established; and the 'steady-state' period (30 plus years) once the option under consideration is fully established.

Table 16.1 and 16.2 display the effect table for the transitional period and the steady-state period in the Hodgson Creek analysis. The tables are also shaded; the darkest shaded cells indicate a score in the lower 30% of the score range, the un-shaded cells the top 30% of the score range, and the light shaded cells show the intermediate scores

Table 16.2. Effects table for the transitional period (years 5-10)

Performance criterion	An approximation of current land-use	High-priority salinity prevention	Medium-priority salinity plantings	Additional under-used areas	Commercial plantations (with corporate land ownership)	Commercial plantations (with leased land)	Private Medium-sized Plantations	Agroforestry (Plantations and grazing)
Economic								
Forestry revenue – growth	1	1	1	1	1	5	1	1
Forestry revenue – royalty	1	1	1	1	1	5	1	1
Infrastructure costs	10	10	10	10	10	10	10	10
Regional impact	1	3	4	9	10	10	9	4
Regional output ($)	9	9	9	8	7	7	7	10
Profit (regional)	10	6	5	3	3	3	3	4
Profit (farm)	10	6	5	3	1	1	1	2
Property value	8	8	8	8	8	8	8	8
Risk profile	9	5	5	5	7	7	7	4
Risk of policy change	8	10	9	9	9	7	7	7
Equity of financial returns	10	9	9	8	7	7	7	9
Cash flow – upfront costs	8	7	6	4	3	10	3	3
Cash flow – debt servicing	8	7	6	4	3	10	3	3
Critical mass	1	2	2	3	4	4	4	3
Flexibility of land-use	10	2	2	2	2	2	2	3
Liquidity of assets	10	1	1	1	1	1	1	1
Environmental								
Shelter effects	1	2	3	4	4	4	4	6
Soil resource quality	1	4	4	4	4	4	4	4
Carbon sequestration	1	6	7	9	10	10	10	9
Water quality	1	3	4	6	7	7	7	6
Salinity control	1	3	4	5	6	6	6	5
BioD (local native)	1	2	3	4	4	4	4	5
Water quantity	10	8	7	6	6	6	6	7
Cumulative impacts	10	10	10	10	10	10	10	10
Displacement of existing native bio systems	10	9	8	7	7	7	7	7
Habitat quality	1	2	3	3	4	4	4	3
Pest habitat	8	8	7	6	6	6	6	7
Air quality (spraying of agrichemicals)	7	6	5	4	3	3	3	3
Social								
Aesthetic amenity	9	10	10	8	8	8	9	9
Change management	10	4	4	8	10	10	8	4
Consistency with government regulation/policy	9	10	10	9	9	9	9	9
Net employment	1	5	7	9	9	9	10	5
Maintaining services	1	5	7	9	9	9	10	5
Community capacity	1	4	5	6	7	7	7	6
Community cohesion	5	7	7	7	5	5	5	6
Community acceptance	5	7	7	7	5	5	5	6
Population turnover	7	7	7	7	5	5	5	5
Equity	5	6	6	6	5	5	5	5
Community health	5	5	5	5	5	5	5	5
Health effects on family	5	5	5	5	4	4	4	5

Table 16.3. Effects table for the steady-state or equilibrium period (years 30-40)

Performance criterion	An approximation of current land-use	High-priority salinity prevention	Medium-priority salinity plantings	Additional under-used areas	Commercial plantations (with corporate land ownership)	Commercial plantations (with leased land)	Private Medium-sized Plantations	Agroforestry (Plantations and grazing)
Economic								
Forestry revenue – growth	1	6	7	9	10	10	9	6
Forestry revenue – royalty	1	6	7	9	10	7	9	6
Infrastructure costs	10	10	10	10	9	9	10	10
Regional impact	1	2	2	8	9	9	8	4
Regional output ($)	1	2	2	3	4	4	4	3
Profit (regional)	2	5	6	8	10	10	10	8
Profit (farm)	2	10	10	7	5	5	5	4
Property value	2	10	9	9	9	9	9	7
Risk profile	9	8	8	7	7	7	7	8
Risk of policy change	6	8	8	4	2	2	3	4
Equity of financial returns	10	9	9	8	7	7	7	9
Cash flow – upfront costs	10	10	10	10	10	10	10	10
Cash flow – debt servicing	10	10	10	10	10	10	10	10
Critical mass	1	6	6	8	10	10	10	8
Flexibility of land-use	10	1	1	1	1	1	1	2
Liquidity of assets	7	8	8	8	10	10	10	4
Environmental								
Shelter effects	1	3	4	5	6	6	6	8
Soil resource quality	4	6	5	4	4	4	4	5
Carbon sequestration	1	4	5	7	8	8	8	7
Water quality	1	6	7	8	10	10	10	8
Salinity control	1	7	8	8	8	8	8	8
BioD (local native)	1	4	5	6	6	6	6	7
Water quantity	10	9	8	7	7	7	7	8
Cumulative impacts	9	10	10	10	10	10	10	10
Displacement of existing native bio systems	10	9	8	7	7	7	7	7
Habitat quality	1	4	5	6	6	6	6	6
Pest habitat	8	7	6	5	5	5	5	5
Air quality (spraying of agrichemicals)	7	7	6	5	4	4	4	4
Social								
Aesthetic amenity	9	10	10	8	7	7	8	9
Change management	10	10	10	10	10	10	10	10
Consistency with government regulation/policy	9	10	10	9	9	9	9	9
Net employment	1	2	4	4	3	3	4	2
Maintaining services	1	2	4	4	3	3	4	2
Community capacity	3	5	5	5	6	6	6	6
Community cohesion	5	6	6	6	4	4	4	4
Community acceptance	5	6	6	6	4	4	4	4
Population turnover	7	8	8	8	8	8	8	8
Equity	5	7	7	7	7	7	7	7
Community health	5	5	6	7	7	7	7	7
Health effects on family	5	6	6	6	6	6	6	6

16.6 Results of Analysis from the Landholder Perspective

Some of the results from the MODSS analysis are now presented. The results discussed here are primarily from the local landholder perspective. The results from the perspective of officers from the local shire council and extension staff from state government agencies are reported in Appendices 16.3 and 16.4 respectively.

Figure 16.1 presents in graphical form the aggregated performance of the farm forestry options in the transitional period, and Figure 16.2 in the steady-state period. The panels on the left in Figure 16.1 and 16.2 show the performance using the weighted summation aggregation technique, and the panel on the right, the Electré II aggregation technique. In each panel, the top histogram is the aggregate result of the environmental, economic and social criteria. The second histogram depicts only the economic criteria, third the environmental and forth the social.

The panels on the left of Figure 16.1 and 16.2 should be considered first. The height of the bar represents the performance of the option – the higher the bars the better the performance. The numbers that appear on top of each bar is the aggregate score for that option, i.e. the weighted sum of the individual scores against all the criteria. Considering the four histograms in this panel, an option will only be considered to have high overall performance if it achieves average or high scores and no low scores in each histogram, i.e. no poor performance in any of the perspectives (economic, environmental or social).

The panels on the right of Figure 16.1 and 16.2 present the aggregated score using the Electré II aggregation and should be considered second. A guide to interpreting these figures can be found in Chapter 15. These histograms display the ordinal ranking of the options; the numbers that appear in these histograms reflect these rankings. The highest performing option is ranked 1, second highest 2, and so on. If the rank achieved by a particular option does not reflect the score it receives using the weighted summation, further investigation is required. For example, if an option receives a high score in the weighted summation results and a low rank in the Electré II results, then that option probably receives poor scores for a number of criteria and high scores for the others. The criteria against which the option performs poorly should be identified from the effects table (Table 16.2 and 16.3). The graphical representations of the effects table that appear in Appendix 16.1 may be useful in identifying poor performance in individual criteria. The decision-maker should then consider whether these poor performances represent a fatal flaw in this option or if they are compensated for be high performance in the other criteria. Poor performance in criteria that were deemed as highly important by the stakeholders are most likely to fatally flaw an option.

Figure 16.3 depicts the change in relative performance of the options across the two time scales. The lines represent the options, while the arrows attached to the lines indicate the passage of time from the transitional period to the steady-state period. In each plot the ideal point (with high performance in both perspectives) is the top right corner of the graph. Options with a general trend towards this area are improving over time. There are three plots in this figure, representing economic versus environmental performance, environmental versus social performance and social versus economic performance.

The interpretation Figures 16.1 to 16.3 is provided in sections 16.7 and 16.8. Firstly, an overall analysis of the options will be presented in section 16.7; secondly, section 16.8 will present a detailed analysis of each of the individual options.

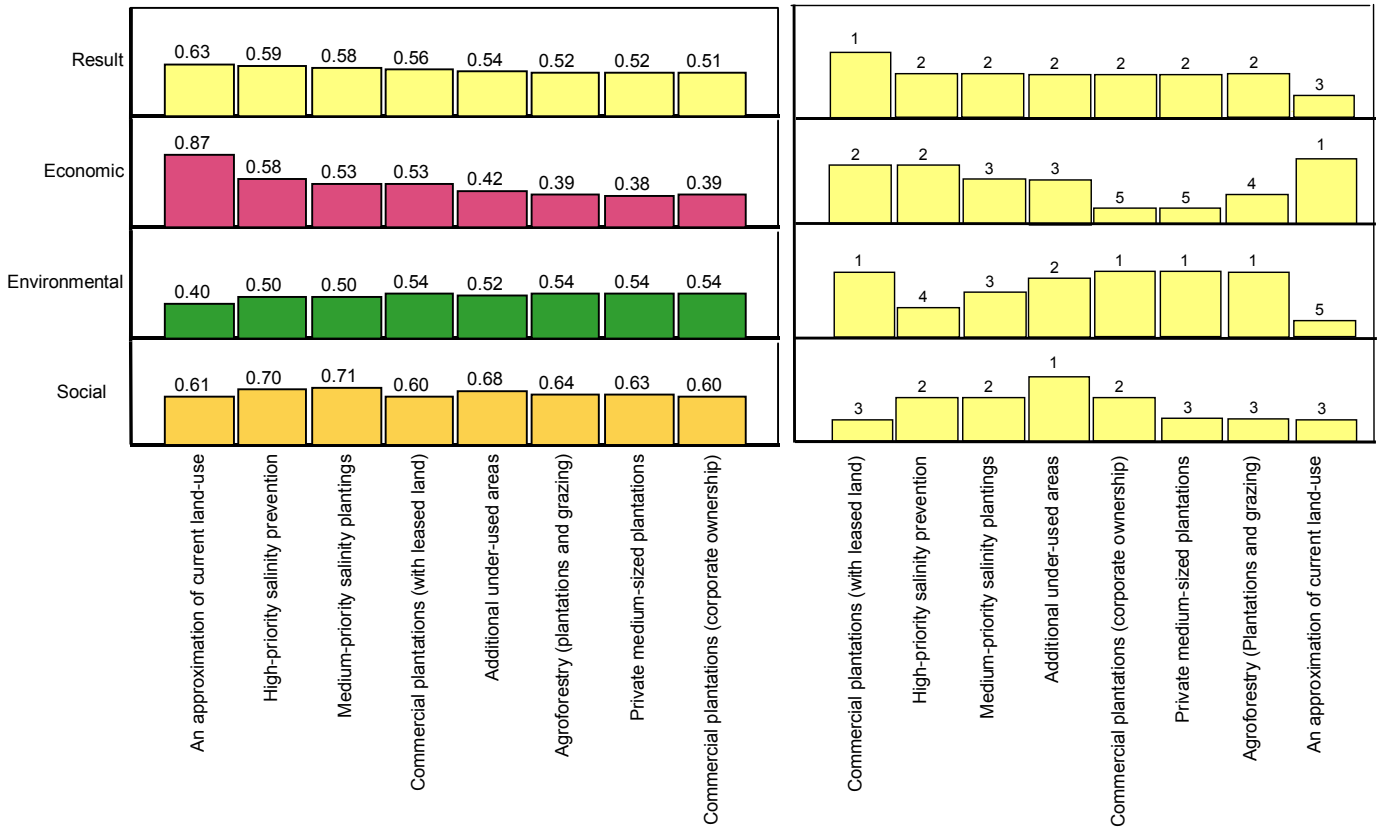


Figure 16.1. Results of the MCA in the transitional period

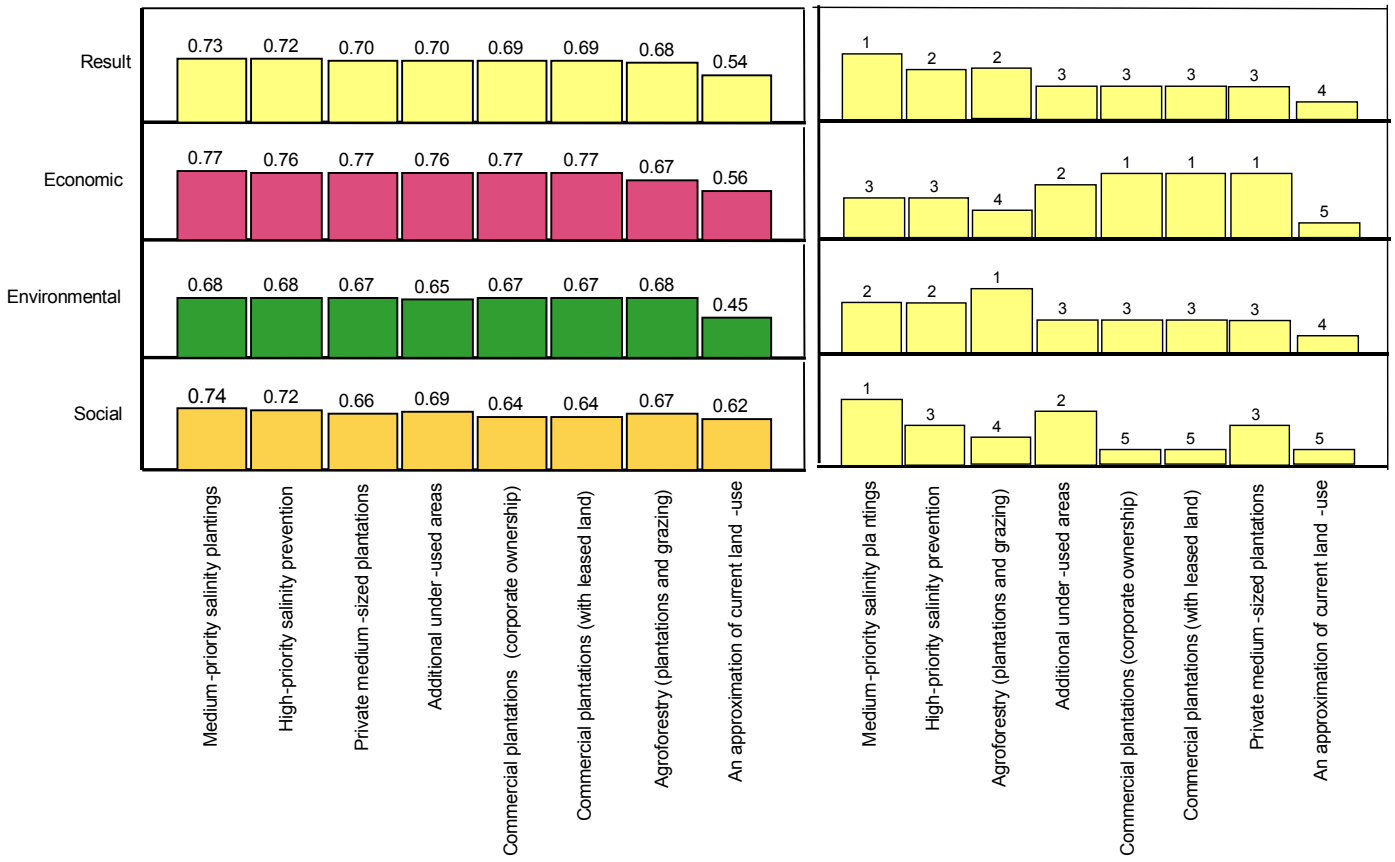
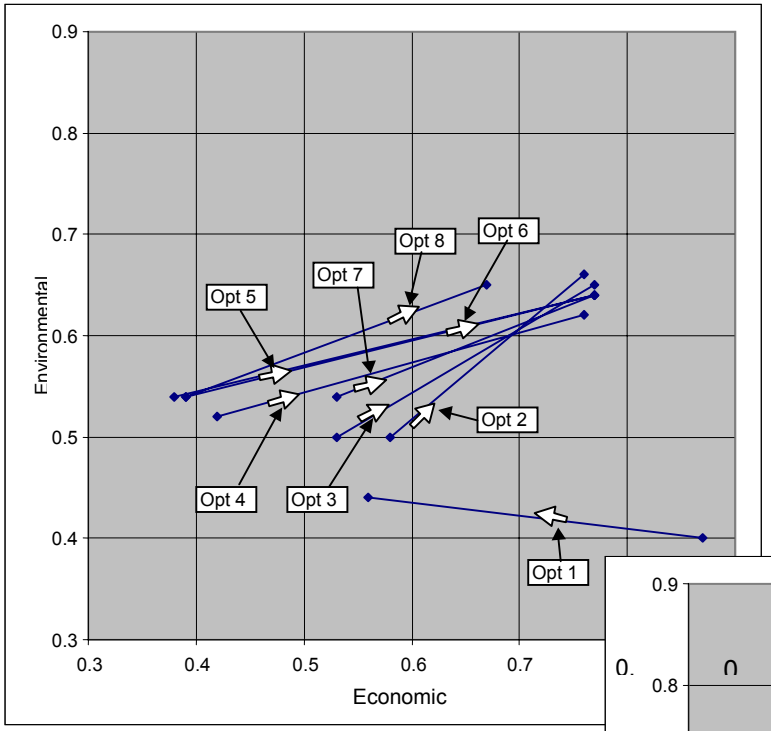
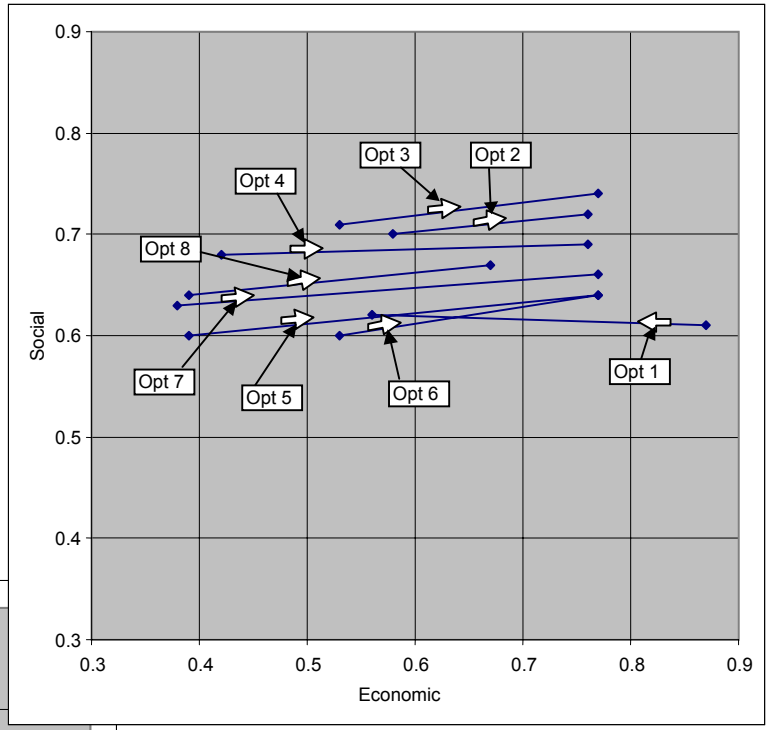


Figure 16.2. Results of the MCA in the steady-state period





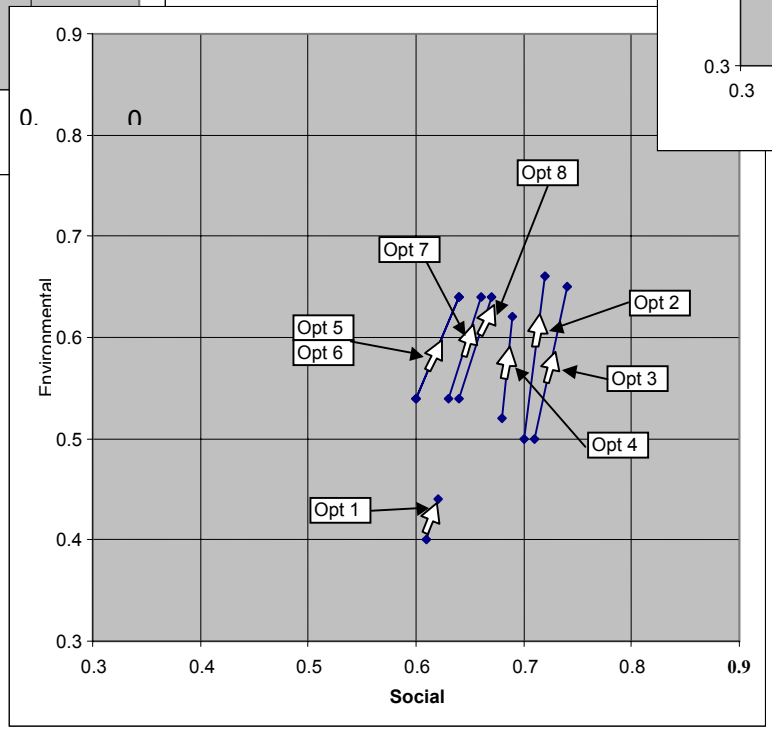


Figure 16.3. Change in relative performance of the options, from the transitional period to the steady-state period

The lines in the panels show the performance of the options, the arrows attached to the lines indicate the passing of time from the transitional period to the steady-state period.

Opt. 1 = An approximation of current land use
Opt. 2 = High priority salinity prevention
Opt. 3 = Medium priority salinity plantings
Opt. 4 = Additional under-used areas
Opt. 5 = Commercial plantations (with corporate land ownership)
Opt. 6 = Commercial plantations (with leased land)
Opt. 7 = Private Medium-sized Plantations
Opt. 7 = Agroforestry (Plantations and grazing)

16.7 Analysis of the Relative Performance of the Options from the Landholder Perspective

The analysis of the farm forestry on the Darling Downs comprised several components. The options were analysed over the transitional and steady-state time periods, and considered from economic, environmental or social perspectives individually, and then from an aggregated perspective in which the economic, environmental and social considerations are integrated and given equal weight. The analysis uses the weighted summation method and the Electré II MCA techniques for aggregating the impacts over the various criteria. The two methods are complementary and aid decision-making. This section will compare the relative performance of the options from the perspective of the economic, environmental and social criteria, and the relative performance of the options across the two time periods considered in the analysis.

Comparison of results using economic, environmental and social criteria, individually and in combination

Using economic criteria alone, in the transitional period 'current practice' is the best option, with high overall performance and no critically poor performance. Other options that perform well are the 'high-priority salinity plantings' and 'commercial plantations (leased land)'. The salinity plantings are small in area and in generally under productive areas so do not displace other land-uses and 'commercial plantations (leased land)' pays annuities. In the steady-state period all the forestry options outperform 'current practice', the large-area forestry options performing best.

Using environmental criteria alone, in both the transitional period and the steady-state period the forestry options outperform 'current practice'. In the transitional period the large-area forestry options, including the 'agroforestry' option, perform better than the small-area forestry options. However in the steady-state period the small-area options outperform the large-area options. The exception to this is the 'agroforestry' option that performs best in the steady-state time period and equal best in the transitional period.

Using social criteria alone in both time periods the small area forestry options perform well, and in the transitional period the 'commercial plantations with leased land' performs well. In the weighted summation analysis 'agroforestry' performs well but not in the Electré II analysis; this may be due to poor performance in a number of criteria.

Using all three major perspectives (economic, environmental and social) aggregated, placing equal weight on each perspective the following observations are noted:

- In the transitional period using the weighted summation analysis all the options fall into a tight range (0.63 to 0.51 on a scale of 1 to 0, 1 being good performance, 0 bad), there is little difference between the options. With in this range, current practice performs best, 'high-priority salinity plantings' and 'medium-priority salinity plantings' perform very similarly to each other and second best, next 'commercial plantations (leased land)' and then the other options. There is a general trend that performance drops as the area planted by trees increases. Considering the Electré II analysis, the results are quite different. The 'commercial plantations (leased land)' option is ranked first, all the other forestry options second and 'current practice' third and last. 'Commercial plantations (leased land)' perform well overall as the scores for the individual criteria are general high and it has few exceptionally poor performing criteria. It scores poorly in the economic criterion of *liquidity of assets* (as do all the forest options) but no others. The drop in performance of 'current practice' is due to critically poor performance in a number of environmental and social criteria.

- In the steady-state period using the weighted summation analysis there is more definition between the options (a range of 0.73 to 0.54). All the forestry options perform similarly with

in the range of 0.73 to 0.68, and all outperform current practice. Using the Electré II method 'medium-priority salinity plantings' performs best with high-priority second then 'agroforestry', followed by all the other forestry options and current practice with the worst performance. The poorer performance of the large-area forestry options is largely due to poor performance in the social group if criteria.

Relative performance of options over time using economic, environmental, social criteria (or all combined)

The time plots (Figure 16.3) show the changes in scores for the options with the passage of time. The arrows indicate the passage of time and point from the transitional score to the steady-state score. The three plots show the environmental scores plotted against the economic, the social against the environmental and the economic against the social.

Apart from option 1, 'current practice', the options exhibit a general trend towards the top right of the panels indicating an improvement in this area. 'Current practice' shows a large decrease in performance in the economic group of criteria, dropping from a score of 0.87 to 0.56. No other option has a drop in performance. 'Current practice' does, however, show a marginal improvement in both the environmental group (0.40 to 0.45) and the social group (0.60 to 0.61).

Whilst it is not possible to analyse the options in detail using these plots (this will be for each option in the next section) a general trends can be identified.

In this analysis all the forestry options exhibit high improvements from all perspectives, the performance of 'current practice' decreases or only improves marginally. Therefore any forestry in this catchment would improve the economy, environment and social wellbeing.

16.8 Performance of Individual Options from the Landholder Perspective

In this section the performance of each option will be discussed in detail. These discussions will draw on the results of the overall analysis and the performance of each option against specific criteria.

Option 1: An approximation of current land-use

Table 16.4 lists the high and low-performing criteria, defined as the criteria with values in the top 30% and lowest 30% of the score range respectively. The evaluation of each option against the set of criteria can be found in table 16.2 and 16.3. A criterion against which an option receives a high score relates to the unshaded cells in table 16.2 and 16.3, a low score relates to the dark shaded cells. The criteria are listed in no particular order.

This option 'Approximation to current land-use' has variable overall performance in the transitional period. It performs well under the weighted summation analysis and poorly under the Electré II analysis. This indicates sound overall performance but with critically poor performance in some criteria. This is highlighted when the perspectives are considered separately. This option easily outperforms the options in the economic perspective but has poor performance in a number of criteria, especially the key criteria of *regional impact*, and the change in regional structure, employment, services and infrastructure. This is however ranked of low importance by the landholders' perspective.

'Current practice' has the poorest performance in the environmental perspective, with poor performance in many criteria, many of which are ranked of high importance.

Table 16.4. High and low scores for an approximation of current land-use

Transitional period high scores	Transitional period low scores	Steady-state period high scores	Steady-state period low scores
		Economic criteria	
Infrastructure costs (community) Regional output ($) Profit (regional) Profit (farm) Property value Risk profile Risk of policy change Equity of financial returns Cash flow – upfront costs Cash flow – debt servicing Flexibility of land-use Liquidity of assets	Forestry revenue – growth Forestry revenue – royalty Regional impact Critical mass	Infrastructure costs (community) Risk profile Equity of financial returns Cash flow – upfront costs Cash flow – debt servicing Flexibility of land-use Liquidity of assets	Forestry revenue – growth Forestry revenue – Royalty Regional impact Regional output ($) Profit (regional) Profit (farm) Critical mass
		Environmental criteria	
Water quantity Cumulative impacts Displacement of existing native bio systems Pest habitat	Shelter effects Soil resource quality Carbon sequestration Water quality Salinity control BioD (local native) Habitat quality	Water quantity Cumulative impacts Displacement of existing native bio systems Pest habitat Habitat quality	Carbon sequestration Water quality Salinity control Biodiversity. (local native)
		Social criteria	
Change management requirements (incl reskilling) Consistency with local state fed government regulation/policy	Maintaining services Community capacity	Change management requirements (incl reskilling) Consistency with local state fed government regulation/policy	Maintaining services Community capacity

From the social perspective this option is amongst a group of lower performing options. With poor performance in *maintaining services* and *community capacity*, the stakeholders rank these criteria as third highest importance in a four-point importance order, as presented in table 16.1.

In the transitional period, this option has high economic performance, poor environmental performance and average social performance. This option has particular poor performance in maintaining employment, local services and infrastructure as well as environmental issues.

In the steady-state period, the overall performance of this option worsens considerably. It has the worst performance overall and in the economic and environmental perspective, although the environmental performance improves slightly. It has average to poor performance in the social perspective, again a slight improvement for the transitional period. It has poor or very poor performance in many important economic criteria.

This option is unlikely to sustain economic viability, and environment protection or maintain employment, local services and local infrastructure.

Option 2: High-priority salinity prevention

Table 16.5 lists the high and low-performing criteria, these being the criteria with scores in the top 30% and the lowest 30% of the score range respectively.

Table 16.5. High and low scores for high-priority salinity prevention

Transitional period high scores	Transitional period low scores	Steady-state period high scores	Steady-state period low scores
		Economic criteria	
Infrastructure costs (community) Regional output ($) Property value Risk of policy change Equity of financial returns	Forestry revenue – growth Forestry revenue – royalty Regional impact Critical mass Flexibility of land-use Liquidity of assets	Infrastructure costs (community) Profit (farm) Property value Risk profile Risk of policy change Equity of financial returns Cash flow – upfront costs Cash flow – debt servicing	Regional impact Regional output ($) Flexibility of land-use
		Environmental criteria	
Water quantity Cumulative impacts Displacement of existing native bio systems Pest habitat	Shelter effects Water quality Salinity control Biodiversity (local native) Habitat quality	Water quantity Cumulative impacts Displacement of existing native bio systems	Shelter effects
		Social criteria	
Aesthetic amenity Consistency with local state fed government regulation/policy		Aesthetic amenity Change management requirements (incl reskilling) Consistency with local state fed government regulation/policy Population turnover	Net employment Maintaining services

In the transitional period, 'High priority salinity plantings' performs well overall. In the weighted summation results, it comes second after 'Current practice', and in the Electré II results it is ranked second on a three point ranking (see Figure 16.1) together with 'Medium priority salinity plantings', 'Additional under-used areas', 'Commercial plantations (with corporate land ownership)', and 'Agroforestry (plantations and grazing)'. Considering only the economic criteria, it is one of the higher-ranking forestry options. It does however have poor performance in some criteria, notably *critical mass*, because the total area forested will be small, and may be insufficient to support a forest industry in the catchment. From an environmental perspective this is one of poorer performing options; performance level of an option and aggregate area planted to forestry appeared to be positively correlated. Socially, it is one of best performing options and has no low scores.

In the steady state this option performs well overall, being the second highest scoring options in the weighted summation and ranked second in a four-point ranking (see Figure 16.2) in the Electré II results. From the economic perspective its performance remains high, although low scores for the criteria *regional impact* and *regional output* cause a drop in performance using the Electré II technique. Performance is also high from the environmental perspective, though falling under the Electré II technique due to the low score for *shelter effects*. Socially, it performs well (second highest score) but drops back to third on a five-point scale in the Electré II analysis due to poor performance in the criteria *net employment* and *maintaining services*.

This option performs well overall but there are concerns that the aggregate area which will be planted is not large enough for a viable forestry industry, signified in a low score for the *critical mass* criterion, and there are only marginal improvements from the environmental and social perspective. There is also a limited potential to maintain employment, local services and infrastructure

Option 3: Medium-priority salinity plantings

Table 16.6 lists the high and low performing criteria for this option. The overall performance in the transitional period is marginally lower than that for 'high priority salinity plantings'. The individual perspectives reflect this trend, with the exception of the environment aspects, in which this option performs better and has fewer critically low scores.

Table 16.6. High and low scores for medium-priority salinity plantings

Transitional period high scores	Transitional period low scores	Steady-state period high scores	Steady-state period low scores
		Economic criteria	
Infrastructure costs (community) Regional output ($) Property value Risk of policy change Equity of financial returns	Forestry revenue – growth Forestry revenue – royalty Critical mass Flexibility of land-use Liquidity of assets	Infrastructure costs (community) Profit (farm) Property value Risk profile Risk of policy change Equity of financial returns Cash flow – upfront costs Cash flow – debt servicing Liquidity of assets	Regional impact Regional output ($) Flexibility of land-use
		Environmental criteria	
Cumulative impacts Displacement of existing native bio systems	Shelter effects Biodiversity (local native) Habitat quality	Salinity control Water quantity Cumulative impacts Displacement of existing native bio systems	
		Social criteria	
Aesthetic amenity Consistency with local state fed government regulation/policy		Aesthetic amenity Change management requirements (incl. reskilling) Consistency with local state fed government regulation/policy Population turnover	

In the steady-state analysis this options performs similarly to 'high priority salinity plantings'. It has similar economic issues but displays a relative increase in performance from the environmental and social perspectives.

Concerns remain about long-term performance due to the size of plantings. These have increased to a level that may provide some water quality and salinity benefit. The viability of this option would depend on the value of the ecosystem services it supplies rather than economic returns.

Option 4: Additional under-used areas

Table 16.7 lists the high and low performing criteria for this option. In the transitional period this option has average performance. It scores at the lower end of the range in the weighted summation

analysis and second in a three-point rank, using Electré II (as do all of the options except 'current practice'). It has similar performance from the economic perspective, with poor financial returns (low scores in *profit -farm and regional*, and *forestry revenue growth and royalty*). From the environmental perspective it has high performance, it's increase performance is relative to its size, it only has on poor performing environmental criteria. It has high performance from the social perspective with a high score using the weighted summation and is ranked first using Electré II.

Table 16.7. High and low scores for additional under-used areas

Transitional period high scores	Transitional period low scores	Steady-state period high scores	Steady-state period low scores
		Economic criteria	
Infrastructure costs (community) Regional impact Regional output ($) Property value Risk of policy change Equity of financial returns	Forestry revenue – growth Forestry revenue – royalty Profit (regional) Profit (farm) Critical mass Flexibility of land-use Liquidity of assets	Forestry revenue – growth Forestry revenue – royalty Infrastructure costs (community) Regional impact	Regional output ($) Flexibility of land-use
		Environmental criteria	
Carbon sequestration Cumulative impacts	Habitat quality	Water quality Salinity control Cumulative impacts	
		Social criteria	
Change management requirements (incl reskilling) Consistency with local state fed government regulation/policy Net employment Maintaining services		Change management requirements (incl reskilling) Consistency with local state fed government regulation/policy Population turnover	

In the steady-state period it maintains a high performance ranking. From the economic perspective it ranks second on a five-point rank. There are some concerns with low scores in *regional output* and *flexibility of land-use*. All the options except 'current practice' score poorly in flexibility of land-use. The establishment time is lengthy relative to other agricultural land-uses. The landholder stakeholder faction places a low rank on this criterion. Environmentally it scores well, with no low ranking criteria. From a social perspective it one of the higher ranking options, with no poor performing criteria.

The forestry operation in this option is reaching a size that may prove viable in the catchment, although it is still sufficiently small to remain acceptable from a social perspective.

Option 5: Commercial plantations (with corporate land ownership)

Table 16.8 lists the high and low performing criteria for this option. In the transitional period this option has poor overall performance, being ranked second (with the all the other options except 'current practice') using Electré II. From the economic perspective it scores low and is ranked last, having poor performance in *profit – regional and farm, cash flow upfront costs and debt servicing*. This reflects the high cost of establishing such an industry, and with corporate ownership profit will return to the parent corporation, not to persons within the catchment. From the environmental perspective it has high overall performance and is raked joint first with the other large forestry options.

It does however have critically low performance in the important environmental criterion of *air quality* due to the requirements for spraying of agricultural chemicals. Socially, it has poor performance generally over all the criteria with no critically poor performance. This option would require corporations to purchase land in the catchment, the effects of which is not currently reflected in the criteria.

Table 16.8. High and low scores for commercial plantations (with corporate land ownership)

Transitional period high scores	Transitional period low scores	Steady-state period high scores	Steady-state period low scores
		Economic criteria	
Infrastructure costs (community) Regional impact Property value Risk of policy change	Forestry revenue – growth Forestry revenue – royalty Profit (regional) Profit (farm) Cash flow – upfront costs Cash flow – debt servicing Flexibility of land-use Liquidity of assets	Forestry revenue – growth Forestry revenue – royalty Infrastructure costs (community) Regional impact Profit (regional) Property value Cash flow – upfront costs Cash flow – debt servicing Critical mass Liquidity of assets	Risk of policy change Flexibility of land-use
		Environmental criteria	
Carbon sequestration Cumulative impacts	Air quality (spraying of agri chemicals)	Carbon sequestration Water quality Salinity control Cumulative impacts	
		Social criteria	
Aesthetic amenity Change management requirements (incl reskilling) Consistency with local state fed government regulation/policy Net employment Maintaining services		Change management requirements (incl reskilling) Consistency with local state fed government regulation/policy Population turnover	Net employment Maintaining services

The overall performance in the steady-state period is high, though marginally lower than the other forestry options. This option is ranked third in a four-point scale using Electré II. From the economic perspective it scores well and is ranked joint first; it does however have poor performance in *risk of policy change* and *flexibility of land-use*. Environmentally, it performs well on the weighted summation analysis but is ranked third in a four-point scale using Electré II, having a low score for *air quality* due to the need for application of agricultural chemicals. Socially it performs poorly, with a low overall score, and is ranked equal last. There are continuing problems with maintaining employment, local services and infrastructure.

In summary, this option has sound long-term economic prospects, but this comes at a cost to local agriculture and the local community.

Option 6: Commercial plantations (with leased land)

Table 16.9 lists the high and low performing criteria for this option. In the transitional period, this option is ranked first in the Electré II analysis, being one of the highest scoring forestry options in terms of overall score. From the economic perspective it is ranked second in the Electré II analysis. Environmentally, it performs well at this time scale in both analyses, but does have a possibly critically low performance in the important criterion of *air quality* due to the requirements for spraying of agricultural chemicals. Socially, it has overall poor performance but has no critically poor performing criteria.

Table 16.9. High and low scores for commercial plantations (with leased land)

Transitional period high scores	Transitional period low scores	Steady-state period high scores	Steady-state period low scores
		Economic criteria	
Infrastructure costs (community) Regional impact Property value Cash flow – upfront costs Cash flow – debt servicing	Profit (regional) Profit (farm) Flexibility of land-use Liquidity of assets	Forestry revenue – growth Infrastructure costs (community) Regional impact Infrastructure costs (community) Regional impact Property value Cash flow – upfront costs Cash flow – debt servicing Critical mass Liquidity of assets	Risk of policy change
		Environmental criteria	
Carbon sequestration Cumulative impacts	Air quality (spraying of agri chemicals)	Carbon sequestration Water quality Salinity control Cumulative impacts	
		Social criteria	
Aesthetic amenity Change management requirements (including reskilling) Consistency with local state and federal government regulation/policy Net employment Maintaining services		Change management requirements (including. reskilling) Consistency with local regulation/policy state and federal government	Net employment Maintaining services

The overall performance is high in the steady-state period, though marginally lower than the other forestry options. This option is ranked third in a four-point rank. From the economic perspective it scores well and is ranked joint first, though the performance in *risk of policy change* and *flexibility of land-use* is poor. Environmentally, it performs well on the weighted summation analysis but is ranked third in a four-point scale using Electré II, having a low score for *air quality* due to the continuing need for agricultural chemicals. Socially it performs poorly (equal last), with a low overall score. There are continuing problems with maintaining employment, local services and infrastructure.

In summary, this option has sound long-term economic prospects, but this comes at a cost to local agriculture and the local community, although less of a cost than corporately-owned plantations.

Option 7: Private medium-sized plantations

Table 16.10 lists the high and low performing criteria (top 30% and lowest 30% of the performance score range respectively). In the transitional period this option has poor overall performance and is ranked second (with the all the other options except 'current practice') using Electré II. From the economic perspective has the lowest overall score, and has many critically poor performing criteria. From the environmental perspective it performs well, except for the need for spraying agricultural chemicals and hence adverse effect on *air quality*. Socially, it has average performance, with no has no critically low performing criteria.

Table 16.10. High and low scores for private medium-sized plantations

Transitional period high scores	Transitional period low scores	Steady-state period high scores	Steady-state period low scores
	Economic criteria		
Infrastructure costs (community) Regional impact Property value	Forestry revenue – growth Forestry revenue – royalty Infrastructure costs (community) Regional impact Cash flow – upfront costs Cash flow – debt servicing Flexibility of land-use Liquidity of assets	Forestry revenue – growth Forestry revenue – royalty Infrastructure costs (community) Regional impact Infrastructure costs (community) Property value Cash flow – upfront costs Cash flow – debt servicing Critical mass Liquidity of assets	Risk of policy change Flexibility of land-use
	Environmental criteria		
Carbon sequestration Cumulative impacts	Air quality (spraying of agri chemicals)	Carbon sequestration Water quality Salinity control Cumulative impacts	
	Social criteria		
Change management requirements (incl reskilling) Consistency with local state fed government regulation/policy Net employment Maintaining services		Change management requirements (incl reskilling) Consistency with local state fed government regulation/policy Population turnover	

In the steady-state period the overall performance is sound, though marginally lower than the other forestry options (all the options 'except current practice'), being ranked third in a four-point scale. From the economic perspective it is ranked joint first, but does however have poor performance in *risk of policy change* and *flexibility of land-use*. Environmentally, it performs well on the weighted summation analysis but is ranked third in a four-point scale using Electré II, having a low score for *air quality* due to the continuing need for agricultural chemicals. Socially, it has average performance but has no critically low performing criteria, and outperforms the other large-area forestry options.

In summary, this option has potentially high economic returns in the long term, but has adverse features concerning cash flow and debt servicing in the transitional period. There are also continuing issues with spraying of agricultural chemicals and the perceived health effects.

Option 8: Agroforestry (plantations and grazing)

Table 16.11 lists the high and low performing criteria for this option. In the transitional period this option has poor overall performance and is ranked second (with most of the forestry options). From the economic perspective is has poor overall performance and is ranked fourth on a five-point scale. Environmentally, it has overall high performance and is ranked joint first. The scores are low for *habitat quality* and *air quality* (agricultural chemical spraying). From the social perspective overall performance is average using the weighted summation aggregation but ranked joint last using Electré II. It is ranked highly by landholders on the social criteria of *aesthetic amenity*, which is one of joint most important social criteria.

Table 16.11. High and low scores for agroforestry (plantations and grazing)

Transitional period high scores	Transitional period low scores	Steady-state period high scores	Steady-state period low scores
	Economic criteria		
Infrastructure costs (community) Regional output ($) Property value Equity of financial returns	Forestry revenue – growth Forestry revenue – royalty Regional impact Cash flow – upfront costs Cash flow – debt servicing Critical mass Flexibility of land-use Liquidity of assets	Infrastructure costs (community) Risk profile Equity of financial returns Cash flow – upfront costs Cash flow – debt servicing Critical mass	Regional output ($) Flexibility of land-use
	Environmental criteria		
Carbon sequestration Cumulative impacts	Habitat quality Air quality (spraying of agri chemicals)	Water quality Salinity control Water quantity Cumulative impacts Cumulative impacts Shelter effects	
	Social criteria		
Aesthetic amenity Consistency with local state fed government regulation/policy		Change management requirements (incl reskilling) Consistency with local state fed government regulation/policy Population turnover Aesthetic amenity	Net employment Maintaining services

In the steady-state period in the overall analysis this option has the second lowest score, being superior to 'current practice' only. It is however ranked second on a four-point scale using the Electré II technique. From the economic perspective it again ranks ahead of 'current practice' only. With critically poor performances in *regional output* and *flexibility of land-use*, and also has low scores in *profit* and *forestry revenue*, this reflects doubt about the quality and value of forestry products from this planting regime. Environmentally, in the steady-state period this option outperforms all the others, with no poor performing criteria. The social performance is average using the weighted summation

and is ranked four on a five-point scale using Electré II. It has low scores in *net employment* and *maintaining services*, but scores well in the important criterion of *aesthetic amenity*.

In summary, this option offers marginal economic benefits but extensive environmental benefits. There is a perception that this planting regime is similar to the pre-cleared appearance of the landscape.

16.9 Comparison between Analysis from a Landholder Perspective and that using Importance Orders of other Stakeholder Groups

The analysis so far has only been concerned with the results using the importance order from the landholders' perspective. The other two stakeholder groups were officers from the local Shire council and extension staff from State government agencies. The analysis was repeated using the importance orders supplied by these factions. The rankings obtained are reported in Appendices 16.3 and 16.4 respectively. The discussion of the results from the landholder perspective is not repeated, but differences between the results will be highlighted and discussed for the other factions.

Considering the importance order supplied by officers from the local Shire council, the following differences are noted.

1. In the transitional period, there is no change in outcomes relative to those of the analysis using the landholder preferences. There is less difference between the options using the weighted summation, but the Electré II results remain unchanged, relative to the analysis using the landholder preferences. The commercial plantation with leased land has improved performance from the economic perspective. Environmentally, the smaller-area forestry options and especially the high-priority salinity plantings show improved performance, with the large-area forestry options having a decrease in performance. Socially, the option of current practice exhibits a drop in absolute performance but maintains its relative position.

2. In the steady-state period there is little or no difference in the relative performance of the other options. Exceptions are the commercial plantation options that improve their relative performance in the social perspective.

3. Finally, considering the time plots, the economic and environmental considerations remain unchanged – the trends present in the analysis for the landholder stakeholder faction are still present. For the social perspective, all the forestry options exhibit a decline in performance in the steady state from the transitional state.

Considering the importance order supplied by extension staff from State government agencies, the following differences are noted relative to the analysis using the landholder preferences.

1. In the transitional period in the overall analysis the option commercial plantation with leased land has higher performance, equaling current practice under the weighted summation, and is ranked first using Electré II. High and medium salinity prevention plantings also have higher performance, and are first using Electré II. This higher performance for all three options is largely due to their superior economic performance. Environmentally, the 'agroforestry (plantings and grazing)' option outperforms all the other options. Performance is similar to that using the landholder preferences from a social perspective.

2. In the steady-state period there is less definition between the options, but the relative performance remains the same.

3. In the time plots, the larger forestry options have marginally better economic performance in and marginally lower social performance. Performance is similar to that using the landholder preferences from the environmental perspective.

16.10 Conclusions and Recommendations

All the forestry options outperform 'current practice' from most perspectives at both time periods. The major exception is the transitional time period, from an economic perspective, were current practice outperforms all of the forestry options. For forestry to be a viable option in this catchment, measures need to be taken to ameliorate this poor economic performance.

The option of 'commercial plantations (with leased land)' is the best performing forestry option from the economic perspective in the transitional period. This is largely due to the payment of annuities to the landholder by the organisation leasing their land. This option has high overall economic and environmental performance at both time scales. *Air quality* was a major environmental consideration for landholders present at the stakeholder meeting; large-scale forestry requires aerial spraying of agricultural chemicals. Alternative methods of applying these chemicals would need to be considered, for this option to be acceptable in this catchment. This option has average performance in the social perspective under the weighted summation analysis and poor performance in the Electré II analysis, in the steady-state period. This is largely due to poor performance in the criteria *net employment* and *maintaining services;* every option has a low score in these criteria. 'Commercial plantations on leased land' score 3 out of 10, and the best options ('medium-priority salinity plantings', 'additional under-used areas' and 'private medium-sized plantations') score 4 out of 10 in the steady-state period. This suggests that the root of these problems lays elsewhere and is not going to be solved in the long term by introducing a forestry industry in the catchment. This option does however score well against these criteria in the transitional period. In both time periods, 'current practice' scores poorly (1 out of 10) in these criteria.

The options 'additional under-used areas' is also worthy of further consideration, especially if the areas are also those identified where forests may aid salinity prevention. This option has high performance from the environmental and social perspectives at both time scales. Environmentally, it does not perform as high as the larger area forestry options because the forested area is considerably smaller. The steady-state economics are sound, but the effect on the regional economy would be small because the planted areas are small. The small area planted under of this option leads to problem in the transitional period, the option having low scores in *critical mass* and farm and *regional profitability*. This poor performance could be ameliorated by large-scale forestry being established in neighbouring areas. This small-scale industry could piggyback on a nearby large-scale plantation forestry industry, and therefore is worth considering in combination with the previous option.

The 'agroforestry' option, whilst it has major concerns due to poor performance in key economic criteria, is worthy of further consideration for its high performance from both the environmental and social perspectives. Low scores in the important economic criterion of *farm profit* in both time periods may however be insurmountable.